AN EXPERIMENT IN WRITING A PROGRAM FOR PROCESSING THE RESULTS OF TEMPERATURE AND WIND SOUNDINGS IN A DIGITAL COMPUTER

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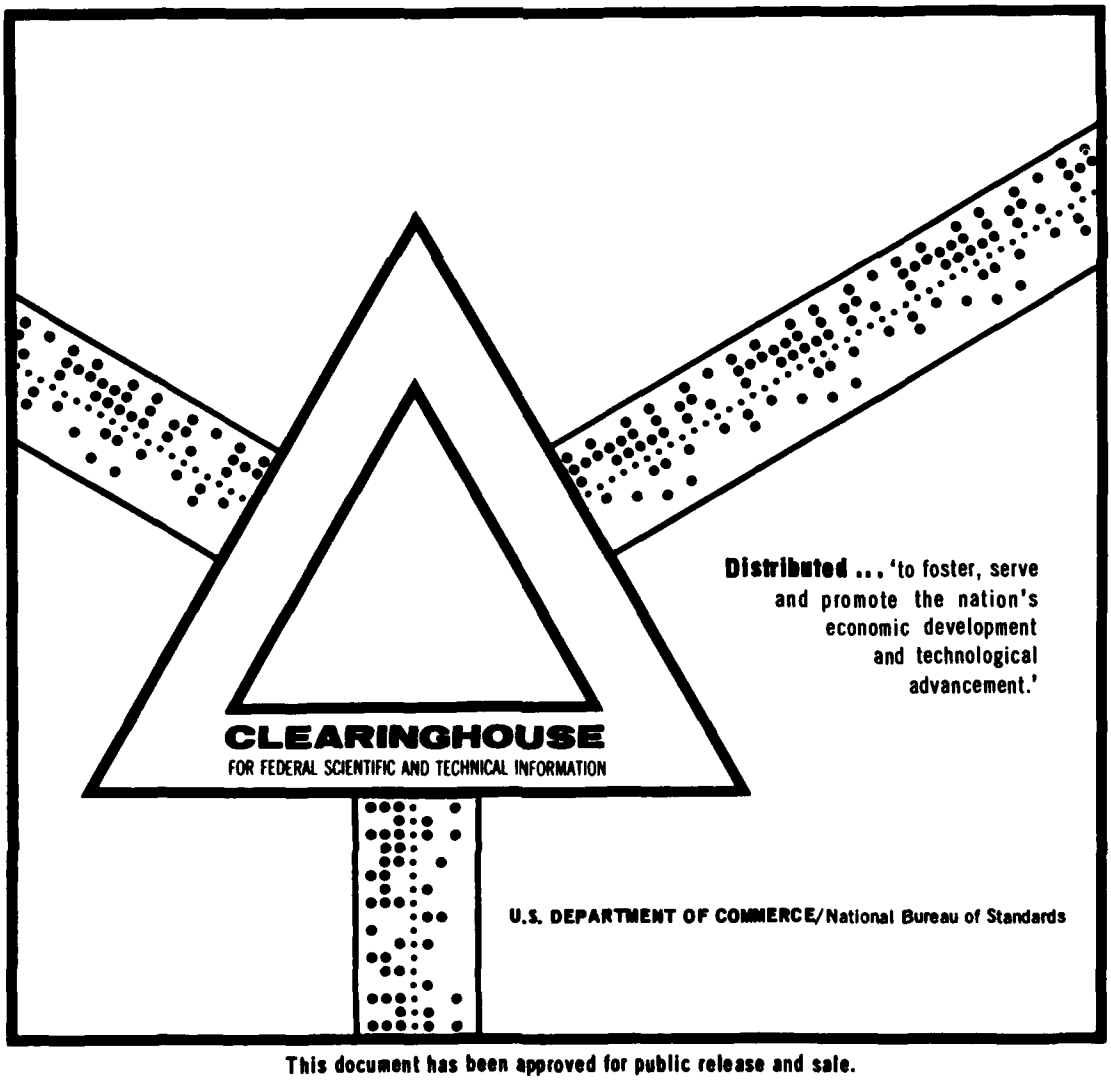

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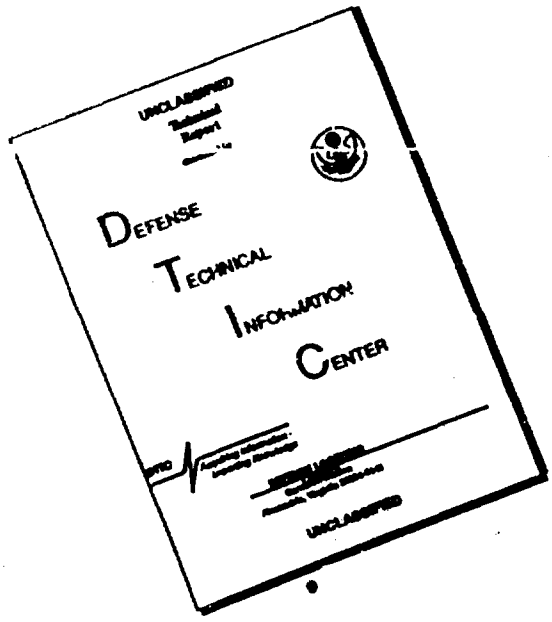

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FOREIGN TECHNOLOGY DIVISION

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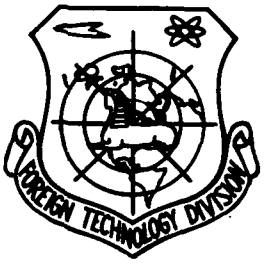
by

D. V. Prashko and G. P. Trifonov



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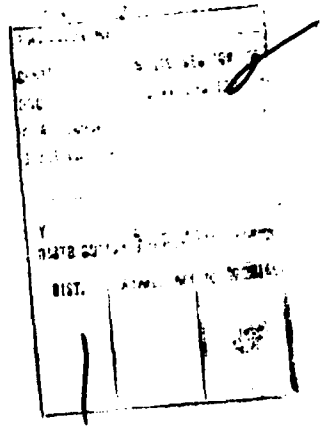

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By: D. V. Prashko and G. P. Trifonov

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ABSTRACT

(U) At aerological network stations, the initial data (temperature and wind) obtained with radiosondes are manually processed. Since the analytical algorithms vary little over long periods of time and can be rigorously described mathematically, this manual work can be completely automated. Such a program, written in Algol-60 language, is described and its applications to other computers are noted.

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Block	Italic	Transliteration	Block	Italic	Transliteration
А а	*А а*	A, a	Р р	*Р р*	R, r
Б б	*Б б*	B, b	С с	*С с*	S, s
В в	*В в*	V, v	Т т	*Т т*	T, t
Г г	*Г г*	G, g	У у	*У у*	U, u
Д д	*Д д*	D, d	Ф ф	*Ф ф*	F, f
Е е	*Е е*	Ye, ye; E, e*	Х х	*Х х*	Kh, kh
Ж ж	*Ж ж*	Zh, zh	Ц ц	*Ц ц*	Ts, ts
З з	*З з*	Z, z	Ч ч	*Ч ч*	Ch, ch
И и	*И и*	I, i	Ш ш	*Ш ш*	Sh, sh
Й й	*Й й*	Y, y	Щ щ	*Щ щ*	Shch, shch
К к	*К к*	K, k	Ъ ъ	*Ъ ъ*	"
Л л	*Л л*	L, l	Ы ы	*Ы ы*	Y, y
М м	*М м*	M, m	Ь ь	*Ь ь*	'
Н н	*Н н*	N, n	Э э	*Э э*	E, e
О о	*О о*	O, o	Ю ю	*Ю ю*	Yu, yu
П п	*П п*	P, p	Я я	*Я я*	Ya, ya

* ye initially, after vowels, and after ъ, ь; e elsewhere. When written as ё in Russian, transliterate as yё or ё. The use of diacritical marks is preferred, but such marks may be omitted when expediency dictates.

AN EXPERIMENT IN WRITING A PROGRAM FOR PROCESSING THE RESULTS OF TEMPERATURE AND WIND SOUNDINGS IN A DIGITAL COMPUTER

D. V. Prashko and G. P. Trifonov

Processing initial data from radiosonde observations of the atmosphere at stations of a aerological network is done manually. Inasmuch as the processing algorithms remain constant for a prolonged period of time and can be strictly described mathematically, the tedious manual processing can be fully automated. The described program performs processing of initial radiosonde observation data in a digital computer. Processing algorithms are written in the "Algol-60" language, which permits their realization without special difficulties in different digital computers, and makes their optimization and improvement convenient.

The processing of aerological information which is obtained in the radiosonde observation process of the atmosphere is done manually. Its deficiencies are low accuracy and considerable labor-consuming nature. For automatic processing of aerological information in 1962 the system "Atmosfera" was created [1]. It was built in such a manner that at the aerological stations there is regulation and refinement of information with the aid of the special-purpose computer "Agat," after which the final processing, up to obtaining the aerological telegram in code KN-04, is produced in the computer center, which is connected with the aerological stations by telegraph communication lines.

Work on the creation of the given program of processing aerological information, issued by the "Agat" machine, began in October of 1964.

In view of the advantages of automatic programming, the entire program, excluding the first unit, was written in the "Algol" language. These advantages are: speed of programming, ease of debugging and improvement of the algorithms. On the other hand, the programs obtained during translation from "Algol" have a slightly greater length and are longer than the programs written according to the same algorithms, but manually. A program was written for a computer having a translator from "Algol."

The basic features of the machine are as follows: high speed operation — near 20,000 operations per second, instruction system — three-address, volume of the core store — 4096 cells, bit configuration — 45 bits, external memory — on magnetic drums and magnetic tape.

Work on writing the program took place according to the following stages:

1) posing the programming assignment;

2) programming the units in "Algol" and their debugging;

3) arrangement of the units into bigger units and their debugging;

4) connecting the units into a single program, recording on tape and complex program error detection and correction.

The developed program consists of 9 units, recorded on the same number of areas of the magnetic tape; the first unit is composed of tables of the program. The volume of each unit is determined by the condition that the length of a program together with the length of the arrays processed by the program did not exceed the

volume of the core store. Initial data for the program is the information obtained in the process of radiosonde observation and represented in coded form on telegraph punched tape. The essence of the coding is that instead of the initial values of weather elements and coordinates, their differences are transmitted, which decreases the excess of information and, consequently, decreases the length of the transmitted telegram. To eliminate the distortions induced by incorrect transmission of increments, transmission of the full values of weather elements and coordinates in a defined number of cycles is foreseen. Furthermore, other measures are provided to protect the telegram from noise. The telegram consists, basically, of three parts: the unit of initial data, including ground values of weather elements and corrections to calibration tables, weather coordinate information, and the notes necessary for the subsequent decoding of the telegram. For full processing of the output of the radiosonde, calibration tables are also needed, which are dispatched beforehand to the computer center and put on punched cards according to the established form. The output result of processing by the program is the aerological output telegram, compiled in international code KN-04 and subsequently utilized by the consumers of the aerological information.

The work of the entire program occurs by means of the sequential execution of units, where each unit, at the beginning of work, reads the initial data necessary for its work from the drum into the core store; upon completion of work of a given unit, the obtained results are copied on the drum, after which into the core store from the magnetic tape the following unit is copied and to it control is transmitted. The block diagram of the program is shown in Fig. 1.

The second unit of the program, written manually due to the great number of operations with parts of the machine word, produces input of the "Agat" aerological telegram from the photoreader, decodes the telegram and restores the initial information in its initial form, where for core economy it records the weather elements and coordinates three to a cell.

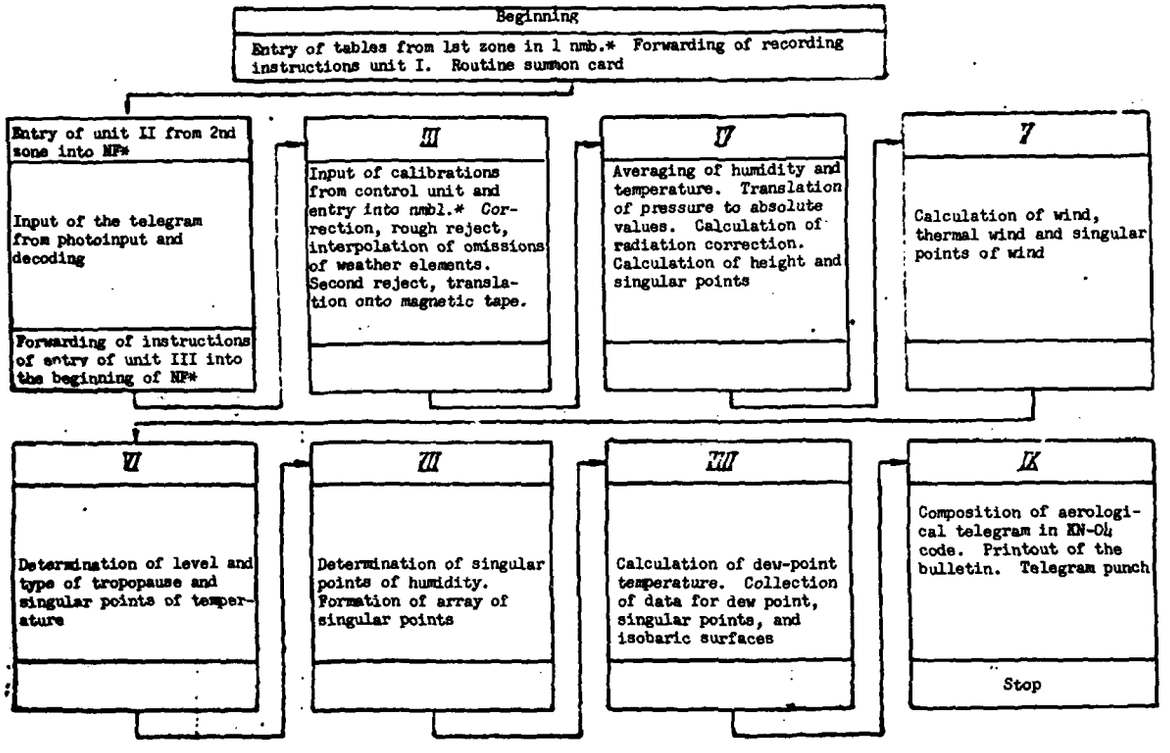

Fig. 1. Block diagram of the computer center program of the "Atmosfera" system [* — Expansion unknown].

The third unit performs unbalance of the array of weather elements, after which in obtained arrays correction is produced by way of restoration of truncated values of weather elements; rejection of knowingly false values of weather elements, and also interpolation of values passed. Then smoothing of the values of pressure is carried out by way of sliding double averaging, where the quantity of points of averaging increases with height.

In the fourth unit averaging of humidity and temperature takes place by means of approximation of the curves of temperature and humidity by segments of a broken line; from the calibration tables the translation of values of weather elements from arbitrary units to absolute occurs. Here radiation correction is calculated, correction in temperatures is introduced and the height of isobaric surfaces and points of sharp bends of the temperature curve are calculated by the hypsometric formula.

The fifth unit executes unbalance of the array of coordinates; it then calculates the velocity and direction of the wind. In the absence of range, the calculation is made by angular coordinates and by height, calculated according to the hypsometric formula. From the calculated values of wind velocity a search is conducted for singular wind points in accordance with the accepted method at the stations, and calculation of the thermal wind is made.

In the sixth unit by analyzing the gradient of temperature the level and type of tropopause is determined, and among the points of breaks of temperature singular points are selected.

Upon finding the singular points of humidity (seventh unit), the humidity for isobaric surfaces, and for singular points of temperature is calculated, after which a search is made along the points of breaks of humidity for values which differ from the values of humidity in singular temperature points and on isobaric surfaces of more than 10%. From the array of singular temperature points and the array of singular humidity points a single array of singular points is created which is regulated by the growth of height.

The eighth unit includes calculation of the dew-point from the values of humidity and temperature, and also calculation of velocity and direction of wind for the tropopause, for singular points and for isobaric surfaces.

All of the information necessary for compiling the aerological telegram and which is obtained as a result of the work of the preceding units, is sent to printout at the beginning of work of the ninth (the last) unit of the program, after which, in accordance with requirements of international code KN-04, the aerological telegram is composed and sent to printout.

The lengths of the programs of the units, as well as their high speed operations, are shown in Table 1. The entire program occupies 8500 decimal cells and takes 4-5 minutes to run (depending upon the volume of initial information). Length of the program and

Table 1.

Number of zones	I	II	III	IV	V	VI	VII	VIII	IX
Length of program	30	1073	1006	1240	1307	840	1038	1089	896
Length of program ♀	192	2324	2450	2982	2163	1482	2350	2517	1735
Length of arrays									
Execution time	3 s	10 s	50 s	80 s	10 s	15 s	40 s	50 s	30-40 s

run time can be decreased considerably under the condition that it is manually written, but the convenience of completion of algorithms and their optimization give considerable advantages to the developed program.

In conclusion, the authors express their gratitude to K. A. Semendyayev for his valuable advice and guidance in the work, and to I. V. Gorelysheva for her aid in the debugging and arranging the whole program.

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